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## NOTES ON COLLECTING CICINDELIDÆ.—II.

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THE four years that have elapsed since the presentation of the author's first Notes on Collecting *Cicindelidæ* have afforded introduction to several rare and very unusual western forms, and have given ample opportunity for a more thorough study of the habits of local species.

Visits to the deep clay gullies in the high prairie southeast of Topeka are each year more richly rewarded than the previous year. On April 2, 1904, over sixty specimens of *splendida* and *amœna* were taken, and with them a specimen each of *purpurea* and *limbalis*, and several *12-guttata*. On March 24, 1905, in the same locality, were taken eighty-eight specimens of *splendida* and *amœna*, three *limbalis*, one *transversa*, and six *12-guttata*; and on March 28, seventy-eight *splendida* and *amœna*, one *limbalis*, one *transversa*, and a dozen *12-guttata*. On other days specimens of *purpurea* and *graminea* were taken, grading closely into each other in color, and with them a single *audubonii*. Two others of the last species were seen, but flew high with the wind and took refuge in the prairie-grass some distance away.

Several visits were made in 1904 and 1905 to the sand-dunes by the river east of town, where *lepidia* was taken commonly in 1902; but either the big June flood of 1903 or the frequent turning over of the sand by the negroes in their attempts to cultivate the soil had apparently forced the delicate creatures to abandon their home. Not a single *lepidia* has been seen since 1902, though the *formosa* varieties are as plentiful there as ever.

The annual Kansas University scientific expeditions to Arizona, under charge of Dr. F. H. Snow, which I have had the good fortune to accompany for the past five years, have offered exceptional opportunity for studying the *Cicindelidæ* of the territory. Our camping place in 1904 was about twenty miles south of Flagstaff, in Oak Creek canyon, a branch of the Verde river. Though a charming place to camp it proved a poor locality for tiger-beetles, the precipitous walls of the canyon acting as a barrier against their encroachment. But a single species was found, *Cicindela maricopa*, a variety of

*oregona*, recently described by Mr. Charles W. Leng from specimens taken on the Salt river at Phoenix. The species had undoubtedly come up the canyon from below, as it is abundant along the Verde river. Mature larvæ, probably of *maricopa*, were observed in their burrows in a sandy field eight or ten feet above stream-level during the latter part of July. The first imago appeared on August 31, and the beetles increased rapidly in numbers during the few remaining days of our stay in the canyon. They occurred all along the stream on areas of damp soil or mud left by a recent flood. The color of the specimens varied through all shades of bright green or blue, the females alone exhibiting the deep purple coloration of the elytra. The variety and luxuriance of color involved in the transition from brown, green or blue to rich purple, in the elytra, was remarkable. An occasional specimen had purplish-brown elytra, with head and thorax only slightly tinged with green, being not far removed from ordinary *oregona*. The markings were broad and very constant. A single *punctulata* was taken at Flagstaff, July 13.

A number of species were taken on the return trip during a stop-over of a day at Albuquerque, N. M., September 5. Most interesting was a variety of *hemorrhagica*, similar in size to *16-punctata*, and probably the same beetle previously taken at Albuquerque by Professor Wickham and determined as *16-punctata*. It differs from *16-punctata* of the Rockies (1) in being dull blue-black instead of brown; (2) in usually lacking the brassy iridescence of the under side and legs, and the bright red and green coloration of the pleura; (3) in the color of the trochanters, which are pale rufous and not polished on the surface; and (4) in having the humeral lunule frequently entire, and the post-marginal (supplementary) and anteapical dots often lacking, never true of *16-punctata*. The two characters, however, that set it apart from any affinity to the *rufiventris* varieties are (1) the sinuate median band, and (2) the fact that the female elytral apices are separately rounded or squared, the apical lunule at the same time receding somewhat from the apical margin. Of the hundreds of *16-punctata* that I have taken the median band is invariably interrupted, or at least reduced to a very narrow line, in the middle, while the elytral apices are always in the female conjointly rounded as in the male. These two characters would at once set apart my specimens of *Cicindela arizonæ*

Wickham from St. George, Utah, as a variety of *hæmorrhagica*, or, better, of *carthagensa*, and not of *rufiventris*.

The specimens of *hæmorrhagica* were found on the muddy margins of pools along roads near the river, in company with brown *sperata* and an occasional *micans*. On bare spots in pastures, where the ground was slightly saline and the grass short, *fulgida* occurred sparingly, and on sand-bars in the Rio Grande were found *sperata*, *ponderosa*, *repanda*, and *vulgaris*. With the last were taken several fine examples of the variety *obliquata*, which were decidedly cupreous in color, and the markings so broad as to in some cases very much resemble those of *venusta*.

On April 1, 1905, I went to St. Louis to accept a scholarship in the Shaw School of Botany, which is connected with the Missouri Botanical Garden. Sunday being my only day of leisure there, I took advantage of the chance to make short suburban detours in quest of the game of my passion--the tiger-beetles.

On April 9, while following a dry, rocky ravine down from the lightly timbered hills at Meramec Highlands, I ran across several specimens of *sexguttata* sunning on the flat rocks and dry leaves. When disturbed they flew either up or down the ravine, or circled back to the same spot. Their occurrence seemed unusual as I had never found the species earlier than May 25 at Topeka. They had evidently hibernated under the rocks and leaves, and the unusually warm weather had brought them to activity. They were all smaller than the same species taken at Topeka, and all 8-dotted. One specimen was a rich blue in color. A single *transversa* was seen while following a road back up the hill. On the following Sunday, which was cold and dismal, specimens of *sexguttata* were found torpid under stones and the bark of logs in timber.

On April 23 a careful search was made for *limbalis* and *transversa* on banks of railroad cuts and gullies. Only two specimens were taken, one a typical *transversa*, the other almost immaculate, with head and thorax scarcely bronzed.

On May 7, two weeks later, while walking carelessly along a road entering the wooded bluffs at Fern Glen, a few miles west of St. Louis, my attention was called to a tiger-beetle that arose from the road before me. In the net it proved to be a beautiful *transversa*. A few steps further on another fell prey to the net, and as I advanced higher into the bluffs and

the timber they seemed to grow more numerous. Presently a pair was found in copula, and then another pair, and soon I realized that here at last I had found the home of *Cicindela transversa*. Not a single *limbalis* was found with them, and only one *transversa* sustained the humeral and posthumeral dots to show any affinity to *limbalis*. On the other hand, a number of the specimens had green or blue head and thorax, agreeing exactly with our eastern forms of *splendida*. Specimens of this last were frequently found in copula with typical *transversa*, thus establishing *splendida* as a variety of *transversa*, and so of *purpurea*. But why had these two species, in this particular locality, abandoned the sun-baked clay-banks and retired to the woods? And why were there no signs here present of the closely associated forms *limbalis* and *amaena*? These two questions remain a puzzle to me.

May 14 was devoted to the capture of *transversa* and *splendida* at Kimmswick, south of St. Louis, and over thirty specimens were taken. They were found along a shady, winding road that ran among the wooded hills, and were more abundant at high elevations. The proportion of the two species was about eight *transversa* to one *splendida*. Fewer pairs were found copulating than on the previous week. *Sexguttata* associated with them, but was much less plentiful. A single *purpurea* was taken along the open road, and several *vulgaris* and *12-guttata* on the banks of a shallow stream. Another trip to the same locality was made on May 28, but the best time for finding *transversa* had apparently passed, as only a few were taken, and those largely imperfect.

The following table attempts to affiliate the numerous varieties of *purpurea*. Forms numbered consecutively are closely related, and each form is derived from the preceding form of higher notation. *C. denverensis* occurs in two forms, corresponding to *splendida* and *amaena* in markings, which have not received distinctive names. *C. cimarrona* has resulted from a fusion of *graminea* and *audubonii*, together with a change of markings, in the high table-lands east of the Rocky Mountains, as shown by a series taken by Doctor Snow in South Park, Colo., which exhibits every possible stage of transition from *graminea* and *audubonii* to *cimarrona*.

I. *Cicindela purpurea* Oliv.

1. *graminea* sch.
  - a. *graminea*, var. (Utah, Or., etc.)
  - b. *lanta* Casey.
  - c. *cimarrona* Lec. (green).
2. *audubonii* Lec.
  - c. *cimarrona* Lec. (black).
  - d. *plutonica* Casey.

II. *C. limbalis* Klug.

1. *amaena* Lec.
- a. *spreta* Lec. (?)
- b. *denverensis* var. (markings complete).

III. *C. transversa* Leng.

2. *splendida* Hentz.
- c. *ludoviciana* Leng.
- d. *denverensis* Casey.

A careful search was made on May 21 for *scutellaris* and *generosa* in sandy fields along the Missouri river, opposite St. Charles; but while *vulgaris* and *repanda* were abundant, no sign could be found of the two species sought. The only possible explanation is that it was too late in season for the one and too early for the other, although the two occur together under like circumstances in May at Topeka.

The most exciting experience of the season was the taking of a series of *unipunctata*, while collecting with my father at Crevecoeur lake, just west of St. Louis, June 6. Arriving rather early in the morning we descended the steep bluff through timber to the edge of the lake, taking a number of *sexguttata* as we did so. I spent most of the forenoon in an aggravating attempt to scoop up a few of the *cuprascens* that ran tantalizingly over the wet mud, without both sinking to the shoulders in the mire and engulfing each specimen in a net full of it when I chanced to sweep half an inch too low. Having by sheer stratagem accomplished the capture of a few of the "critters," and fewer still of *hirticollis*, I was ready and glad to retire to the woods for the noon repast, and to incidentally disencumber myself from the mud.

From the spring we ascended the bluff by a narrow footpath bordered by herbs and creepers. Half way up I engaged in hasty pursuit of a "tiger" that ran across a wide place in the path. I naturally supposed it to be *punctulata*, but in my fingers the peculiar appearance arrested me, and with a flash of consciousness I recognized the insect whose biography I had read many times. Shouting "unipunctata! unipunctata!"

I thrust it before the spectacles of my father, whose seeming lack of enthusiasm provoked me. A hundred feet farther on the rest of the party sat down to lunch under a tree, while I with careful scrutiny patrolled the entire length of the path some dozen odd times, proclaiming each capture of a *unipunctata* with a loud shout. After lunch the search was continued by both of us until late in the day and the beetles had apparently all "gone to roost." Ten specimens rewarded the afternoon's vigilance. The rapidity with which the species can run, and the suddenness with which it can stop under a leaf, are truly amazing. It was noticed that not a single specimen even attempted to fly, and, while I have never seen the statement, I doubt very much if *unipunctata* possesses the power of flight. One specimen did not move until picked up, and a crushed one in the path indicated a similar cause for its fate beneath some foot. How abundant they might have been under cover of the vegetation I cannot tell, for no amount of frequency over the same path seemed to lessen the possibility of finding one on the next round. The thought of overtaking so agile an insect in a dense mat of vegetation kept me closely to the path.

The Kansas University expedition of 1905, located in the valley of San Bernardino creek, twenty miles east of Douglas, Ariz., was productive of unusual results. Twelve species of *Cicindelidae* were taken—the best representation of any trip since the one to Clark county, Kansas, mentioned in my first paper (vol. XIX, Trans. Kan. Acad. Sci., 1904, p. 429).

Several species were taken during stop-over on the way out at El Paso, Tex., July 28. On the fine clay soil, in an arroyo that washes down from the gravel-hills north of town, *lemniscata* was abundant, and from the number of pairs copulating it appeared to be their mating season. Around mud pools in the streets the ordinary brown form of *sperata* fairly swarmed. On mud and sand-bars in the Rio Grande *sperata* and *tenuisignata* were both frequent, with an occasional specimen of *rectilatera*, somewhat smaller and more cupreous than the eastern Texas form, and with only the tip segments of the abdomen rufous, in all respects intermediate between true *rectilatera* and the Mexican *flavopunctata*.

At Douglas we saw *16-punctata* about mud-holes, and while crossing the Perilla mountains found it in untold numbers about the so-called tanks, or watering-holes—cavities in the

great flat masses of rock in which rain-water collects, and where the teamsters water their horses and fill their canteens, in the absence of better water.

Our camp was but a few yards north of the Mexican boundary in a broad, very flat, green, almost treeless valley, bordered by bluffs covered with dense chaparral, beyond which was the parched, limitless mesa—a veritable oasis in the desert. Beside us a noisy artesian well belched forth from an eight-inch pipe clear, warm water, that loitered off through the salt-grass to a pond half a mile below, making the low vegetation doubly green along its path. While pitching the tents I noticed with feverish anxiety an occasional bright green tiger-beetle arise from the bare spots to evade our footsteps, and I could scarcely wait till camp was made to put the net into play; for the ground seemed fairly strewn with them. I mistook the species for *unicolor*. Starting early next morning I returned at noon with over sixty of them. Little did I realize that instead of *unicolor* I had a nice catch of the rare *pimeriana*, known to science by a single specimen taken by the Mexican Boundary Survey years before, possibly in the same valley. The habit of flight was identical with *scutellaris*, and the ground on which they occurred was mostly bare and somewhat sandy. Their remarkable tameness came to be a matter of no little comment, as they ran about the dinner-table devouring the ants that came for crumbs, and we often amused ourselves throwing pebbles at them. On particularly "lazy" days our ambitions would actually degenerate to such a level that we would bottle a few of them to make the catch look bigger. Up and down the valley, however, they were not found, but were confined to a limited area in the vicinity of the artesian well.

The species differs from *unicolor* principally in (1) the highly polished surface; (2) the deep-blue reflections toward the apex; (3) the brassy reflections of head and thorax; (4) the deep, uniform punctuation of the elytra over the entire surface; (5) the minute serrulation of elytral apices; (6) the equal robustness and equal hairiness of the front in the two sexes; (7) the white color of the female labrum; and (8) the light color of all but the tip segments of the palpi. The color is often entirely blue, with the brassy reflections lacking. Most specimens are immaculate, though the median and humeral

dots are often present. The species is a little more slender and less robust than the *scutellaris* varieties.

On damp ground, in freshly irrigated alfalfa and corn-fields, *nigrocærulea* was quite common. It varied from green or brassy-green to deep blue, or even black. It is a rather wary species in bright sunshine, but on cloudy days could be found running amongst the alfalfa. Along the narrow ditch that carried the artesian water *16-punctata* was frequent, but was far outnumbered by *hæmorrhagica*. The latter grew more and more abundant each day after August 1, until by the middle of the month the damp, level ground covered with salt-grass fairly swarmed with them. One could by sweeping his net a few times over the top of the grass as he walked get enough of the "red-ended" fellows to half fill a cyanide bottle. They were nearly all dull black, though an occasional small one had bright cupreous head and thorax, pleura, suture and legs, resembling *16-punctata* except for the markings, the sinuate median band being constantly preserved. Under cow-chips on the same damp soil several *Tetracha carolina* were found.

One of the collectors, while searching for *Carabidæ* along the creek, hit upon a colony of the tiny *Cicindela arizonensis*, at the base of a high and steep east bank of the creek. Further search revealed another colony on a similar strip of bank. When frequent visits to these colonies had nearly exhausted them, a large colony was found in a distant part of the valley, where the grass was short and sparse, and a number of depressions caused by washing water after heavy rains left a series of low, sloping banks, in the shelter and on the sides of which the insects gathered. A few days later specimens were found along irrigating ditches with *lemniscata*, though ordinarily the two species were not found together.

*Arizonensis* flies less readily than *lemniscata*, but is nevertheless quick in its movements. At first sight it somewhat resembles *celeripes*. It is the smallest *cicindelid* of our fauna, and probably the smallest in the world, being yet smaller than *lemniscata* or *celeripes*. The markings consist of apical lunule and median band, often reduced to a dot and, rarely, even lacking. I can see little to separate it from the Mexican *viridisticta*, since Bates's description of the latter says "median marginal dot and very narrow apical lunule white." I should at least place it as a variety of *viridisticta*.

In certain limited areas in dry arroyos entering the valley

from the mesa, on other bare areas scattered over the valley, and along certain irrigating ditches, *lemniscata* was quite common. In company with it I took one day a single small tiger-beetle that thrilled me with excitement. The head and thorax were brown and quite pubescent on the sides, while the elytra were dull red with markings somewhat prolonged, but not fused to form a vitta. The under side was less pubescent than in *lemniscata*, but much more so than in *viridisticta*, so that the insect was in many respects an ideal intermediate between the two species. I at once presumed it to be a hybrid, and on reaching camp announced the capture of a rare "*Cicindela lemnistica*." The following days were devoted to a careful search for more of the hybrids, and as a result a very few more found their way to the boxes. Two or three were also taken at lamplight in the evening along with a lot of *lemniscata*. The cherished hybrids on our return home turned out to be *wickhami*, but were none the less valuable. The markings consist of apical lunule, produced in front, median band set in from the margin and almost parallel to it; and before the band a single dot to indicate the posterior extremity of the humeral lunule. The affinities tend as much toward *lemniscata* as toward *viridisticta*, for the legs show a strong tendency to be pale, in addition to the characters cited above.

A blue specimen of *hornii* was brought to camp by a cowboy who had found it on the mesa. A search was made for them, and two were seen on a damp, sloping stretch of the mesa where the gravel had been covered by a thin soil washed over it by recent rains. Several green *santaclaræ* were taken there, one pair in copula. A few days later, in the latter part of August, a few more green *santaclaræ* and black *vulturina* were taken in the rolling grass-land on the east side of the valley. They were extremely wary, and flew far when alarmed. A day or so before our departure, on September 2, two specimens of *pulchra*, of the unusual western form, with complete markings, were taken near camp in company with the still common *pimeriana*.